Completing the Square: exam questions

10 questions · 29 marks · mark schemes at the end

Name _____ Date _____ Score / 29

- Calculators are allowed on both 4MA1 Higher papers (1H and 2H). Show your working: most marks are for method.
- Mark schemes start after the questions. M marks are for a correct method, A marks for an accurate answer that follows a correct method, and B marks for a correct result on its own.
- Online, with more practice: igcsemathrevision.com/igcse-frontend/4ma1/exam-questions/completing-the-square

1. **2 marks**

Write $x^2 + 8x + 3$ in the form $(x + a)^2 + b$.

2. **3 marks**

(a) Write $x^2 - 6x + 14$ in the form $(x - p)^2 + q$. **(2)**

(b) Write down the coordinates of the turning point of the curve $y = x^2 - 6x + 14$. **(1)**

3. **3 marks**

Write $2x^2 + 12x - 5$ in the form $a(x + b)^2 + c$.

4. 3 marks

By completing the square, solve $x^2 + 10x + 7 = 0$. Give your answers in the form $p \pm q\sqrt{2}$.

5. 4 marks

(a) Write $3 + 4x - x^2$ in the form $a - (x - b)^2$. **(3)**

(b) Hence write down the maximum value of $3 + 4x - x^2$. **(1)**

6. 2 marks

$x^2 + px + q = (x - 5)^2 + 2$ for all values of x.

Find the values of p and q.

7. 2 marks

Show that $x^2 - 4x + 7 > 0$ for all values of x.

8. **3 marks**

By completing the square, solve $x^2 - 3x - 1 = 0$. Give your answers in surd form.

9. **3 marks**

Write $3x^2 - 12x + 20$ in the form $a(x - b)^2 + c$.

10. **4 marks**

$f(x) = x^2 + 6x + 11$

(a) Write $f(x)$ in the form $(x + a)^2 + b$. **(2)**

(b) Hence solve $f(x) = 27$. **(2)**

Answers and worked solutions

Question 1 — 2 marks

M1 $(x+4)^2 - 16 + 3$

A1 $(x+4)^2 - 13$

Answer: $(x+4)^2 - 13$

Question 2 — 3 marks

(a)

M1 $(x-3)^2 - 9 + 14$

A1 $(x-3)^2 + 5$

(b)

B1 $(3, 5)$

Answer: (a) $(x-3)^2 + 5$; (b) $(3, 5)$

Question 3 — 3 marks

M1 $2(x^2 + 6x) - 5$

M1 $2(x+3)^2 - 18 - 5$

A1 $2(x+3)^2 - 23$

Answer: $2(x+3)^2 - 23$

Question 4 — 3 marks

M1 $(x+5)^2 - 25 + 7 = 0$

M1 $(x+5)^2 = 18$, $x + 5 = \pm\sqrt{18}$

A1 $x = -5 \pm 3\sqrt{2}$

Answer: $x = -5 \pm 3\sqrt{2}$

Question 5 — 4 marks

(a)

M1 $-(x^2 - 4x) + 3$

M1 $-\left((x-2)^2 - 4\right) + 3$

A1 $7 - (x-2)^2$

(b)

B1 7

Answer: (a) $7 - (x-2)^2$; (b) 7

Question 6 — 2 marks

B1 $p = -10$

B1 $q = 27$

Answer: $p = -10$, $q = 27$

Question 7 — 2 marks

M1 $(x-2)^2 + 3$

A1 $(x-2)^2 \geqslant 0$, so $(x-2)^2 + 3 \geqslant 3 > 0$

Answer: shown

Question 8 — 3 marks

M1 $\left(x - \frac{3}{2}\right)^2 - \frac{9}{4} - 1 = 0$

M1 $\left(x - \frac{3}{2}\right)^2 = \frac{13}{4}$

A1 $x = \dfrac{3 \pm \sqrt{13}}{2}$

Answer: $x = \dfrac{3 \pm \sqrt{13}}{2}$

Question 9 — 3 marks

M1 $3(x^2 - 4x) + 20$

M1 $3(x-2)^2 - 12 + 20$

A1 $3(x-2)^2 + 8$

Answer: $3(x-2)^2 + 8$

Question 10 — 4 marks

(a)

M1 $(x+3)^2 - 9 + 11$

A1 $(x+3)^2 + 2$

(b)

M1 $(x+3)^2 = 25$, $x + 3 = \pm 5$

A1 $x = 2$ or $x = -8$

Answer: (a) $(x+3)^2 + 2$; (b) $x = 2$ or $x = -8$

Online, with every solution: igcsemathrevision.com/igcse-frontend/4ma1/exam-questions/completing-the-square
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